Electron Transport System

- NADH and FADH2 carry electrons to the ETS
- ETS is a series of electron carriers located in cristae of mitochondria
- Energy from electrons transferred to ATP synthase
- ATP synthase catalyzes the phosphorylation of ADP to ATP
- Water is formed

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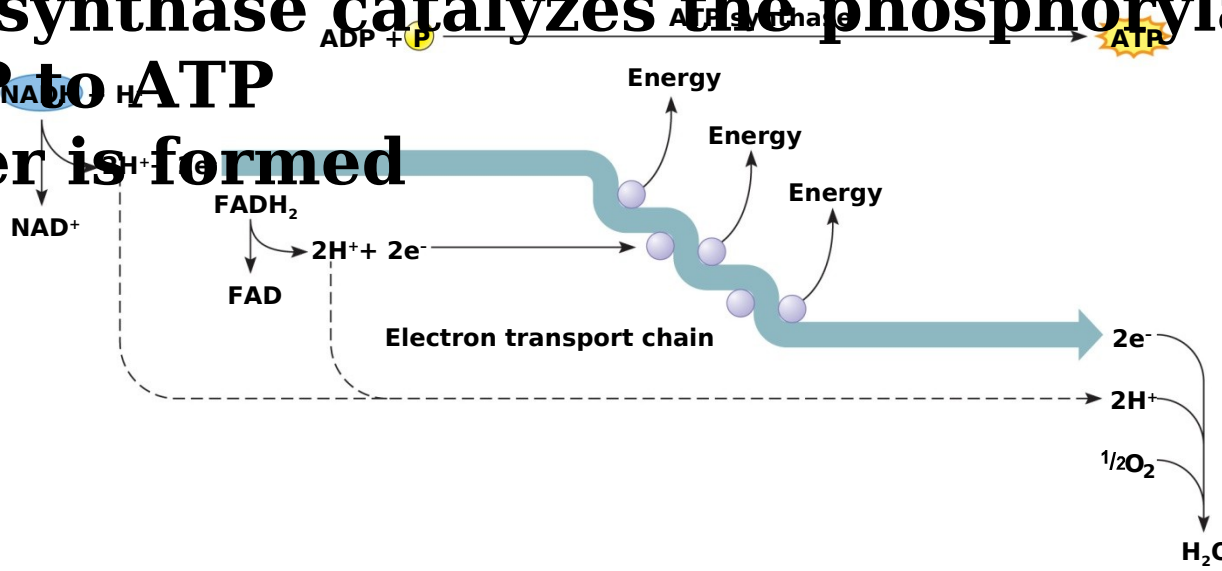

Summary of Cellular Respiration

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Glycolysis

1 The 6-carbon sugar glucose is broken down in the cytosol into two 3-carbon pyruvic acid molecules with a net gain of 2 ATP and release of high-energy electrons.

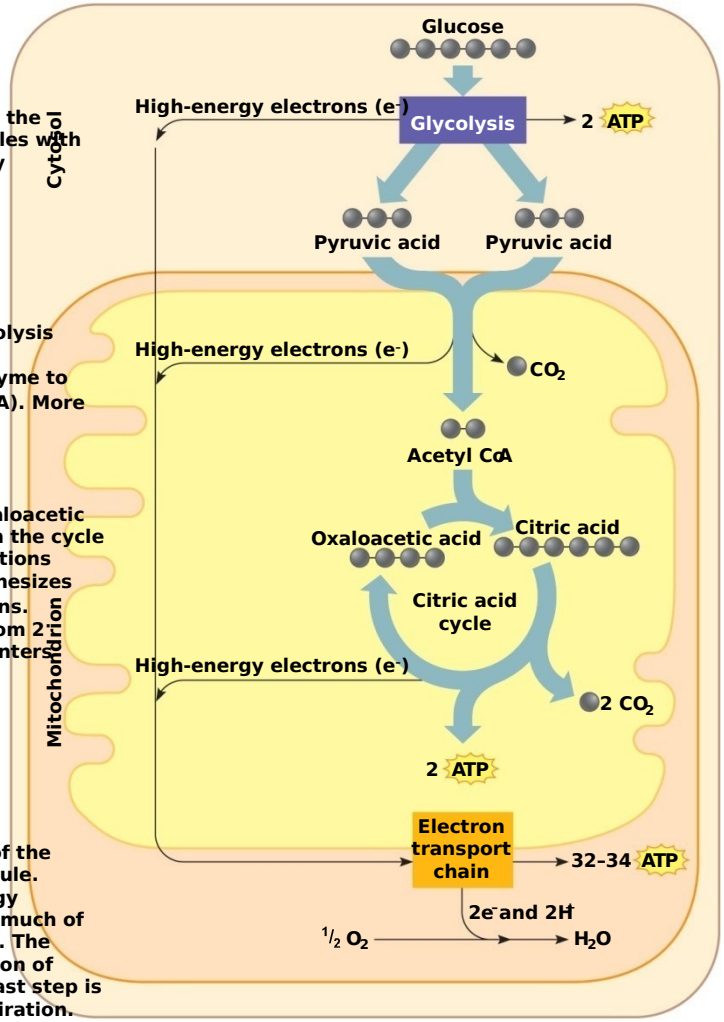
Citric Acid Cycle

2 The 3-carbon pyruvic acids generated by glycolysis enter the mitochondria. Each loses a carbon (generating CO_2 and is combined with a coenzyme to form a 2-carbon acetyl coenzyme A (acetyl CoA). More high-energy electrons are released.

3 Each acetyl CoA combines with a 4-carbon oxaloacetic acid to form the 6-carbon citric acid, for which the cycle is named. For each citric acid, a series of reactions removes 2 carbons (generating 2 CO_2's), synthesizes 1 ATP, and releases more high-energy electrons. The figure shows 2 ATP, resulting directly from 2 turns of the cycle per glucose molecule that enters glycolysis.

Electron Transport Chain

4 The high-energy electrons still contain most of the chemical energy of the original glucose molecule. Special carrier molecules bring the high-energy electrons to a series of enzymes that convert much of the remaining energy to more ATP molecules. The other products are heat and water. The function of oxygen as the final electron acceptor in this last step is why the overall process is called aerobic respiration.



Carbohydrate Storage

- **Carbohydrate molecules from foods can enter:**
  - **Catabolic pathways for energy production**
  - **Anabolic pathways for storage**

Carbohydrate Storage

Excess glucose stored as:

- **Glycogen (primarily by liver and muscle cells)**
- **Fat**
- **Converted to amino acids**

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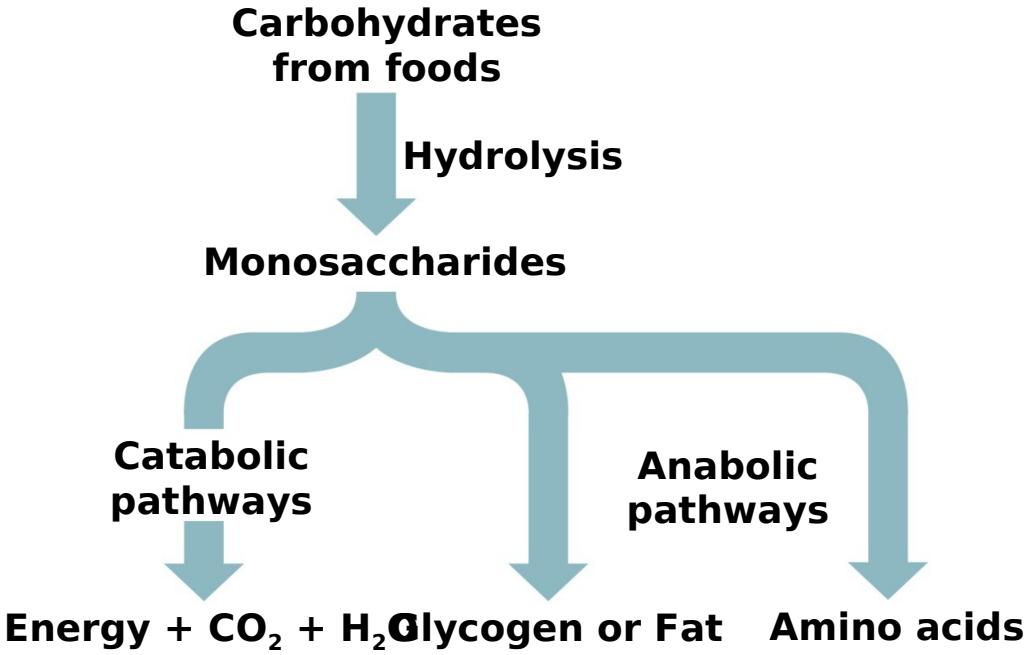

Summary of Catabolism of Proteins, Carbohydrates, and Fats

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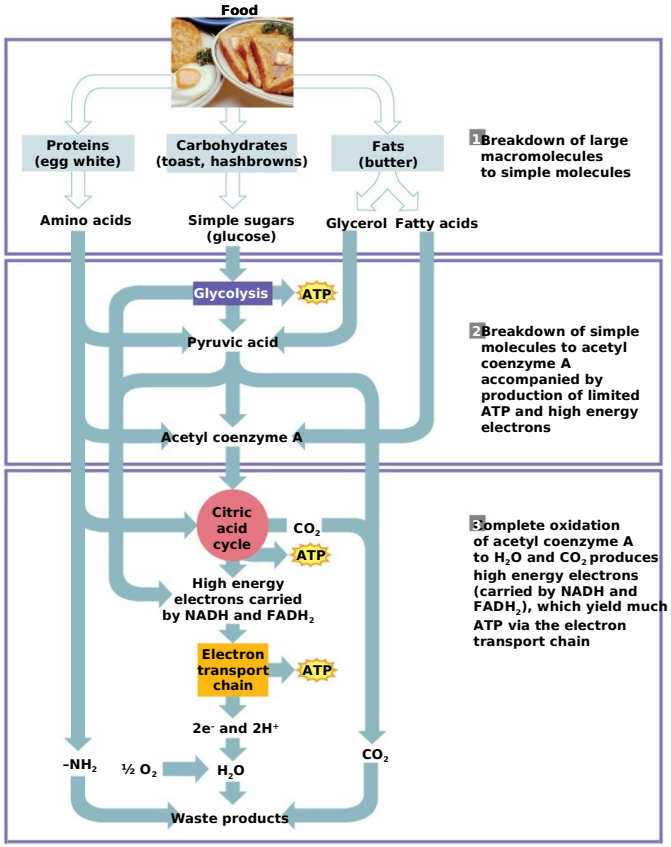
Food
Proteins (egg white)
Carbohydrates (toast, hashbrowns)
Fats (butter)
1 Breakdown of large macromolecules to simple molecules
Amino acids
Simple sugars (glucose)
Glycerol
Fatty acids
Glycolysis
ATP
Pyruvic acid
2 Breakdown of simple molecules to acetyl coenzyme A accompanied by production of limited ATP and high energy electrons
Acetyl coenzyme A
Citric acid cycle
CO_2
ATP
3 Complete oxidation of acetyl coenzyme A to H_2O and CO_2 produces high energy electrons (carried by NADH and $FADH_2$), which yield much ATP via the electron transport chain
High energy electrons carried by NADH and $FADH_2$
Electron transport chain
ATP
$2e^-$ and $2H^+$
$-NH_2$
$\frac{1}{2}$ O_2
H_2O
CO_2
Waste products

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4.6: Nucleic Acids and Protein Synthesis

- **Instruction of cells to synthesize proteins comes from a nucleic acid, DNA**

Genetic Information

- **Genetic information – instructs cells how to construct proteins; stored in DNA**

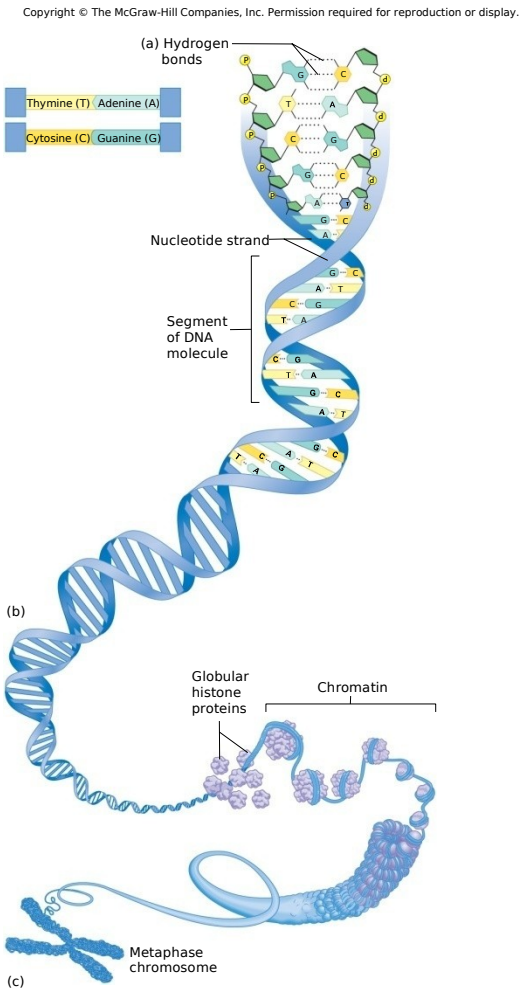
Gene – segment of DNA that codes for one protein

- **Genome – complete set of genes**

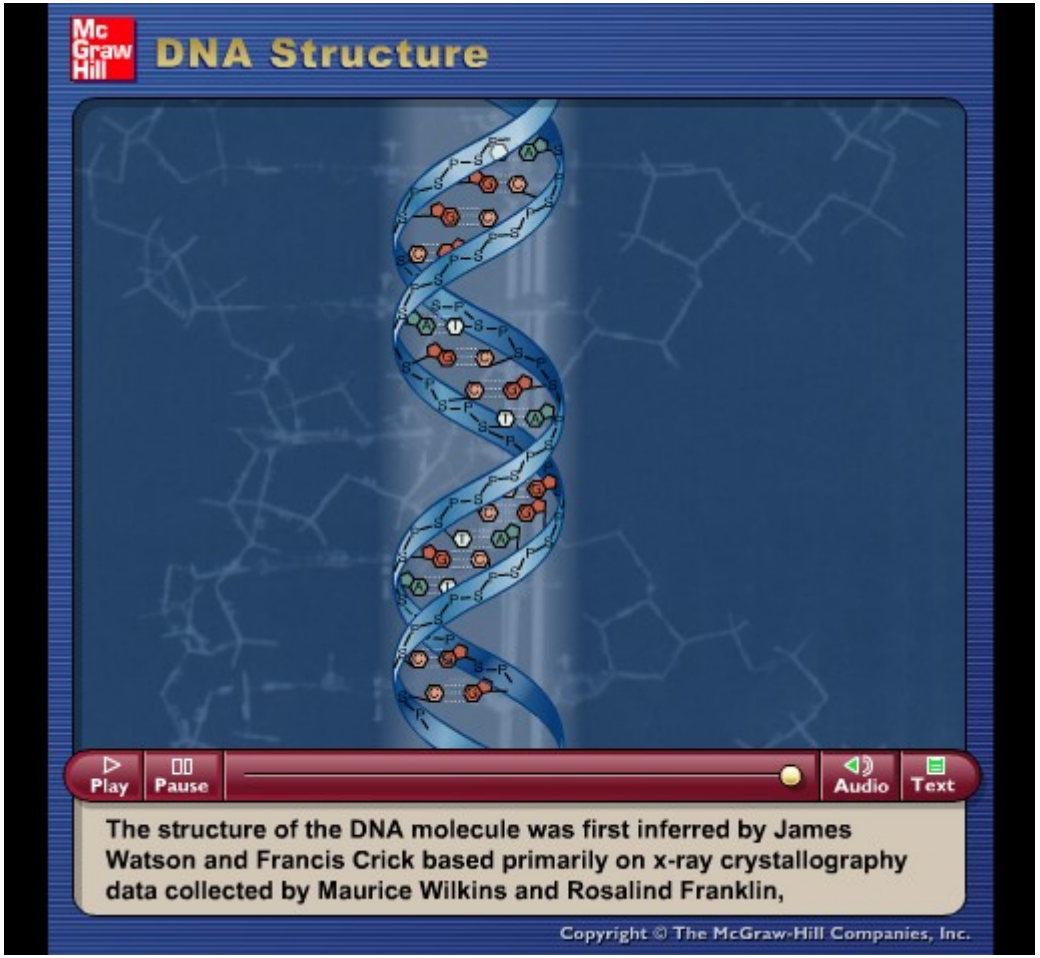
- **Genetic Code – method used to translate a sequence of nucleotides of DNA into a sequence of amino acids**

Structure of DNA

- **Two polynucleotide chains**
- **Hydrogen bonds hold nitrogenous bases together**
- **Bases pair specifically (A-T and C-G)**
- **Forms a helix**
- **DNA wrapped about histones forms**



Animation: DNA Structure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DNA Structure
Play
Pause
Audio
Text
The structure of the DNA molecule was first inferred by James Watson and Francis Crick based primarily on x-ray crystallography data collected by Maurice Wilkins and Rosalind Franklin,
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DNA Replication

- **Hydrogen bonds break between bases**
- **Double strands unwind and pull apart**
- **New nucleotides pair with exposed bases**
- **Controlled by DNA polymerase**

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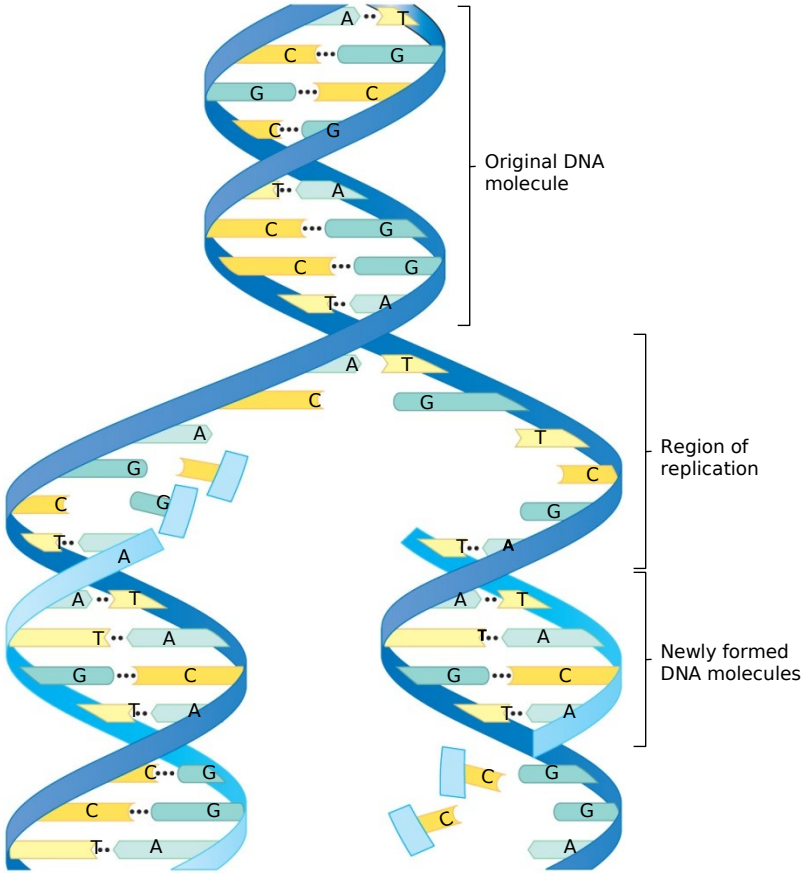
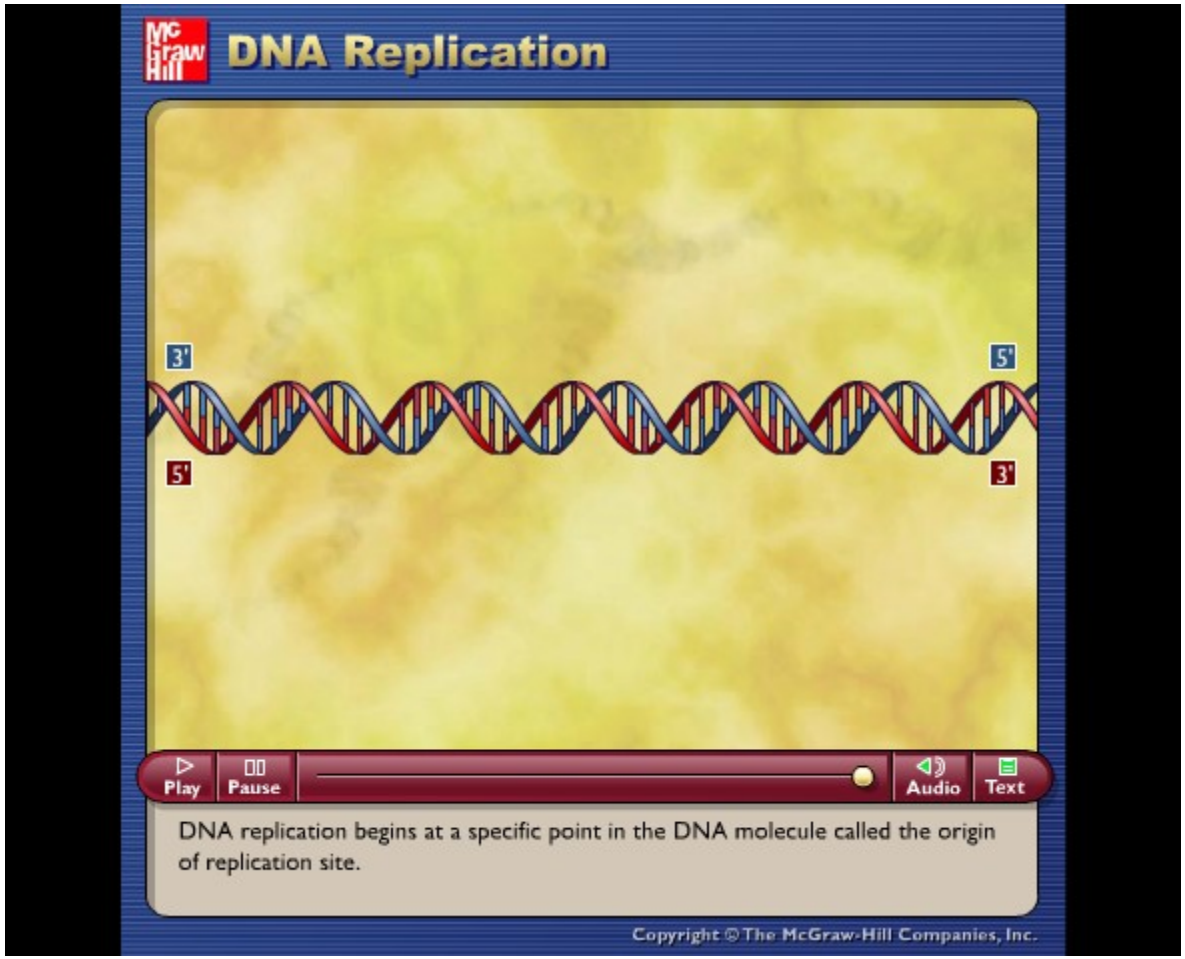


Animation: DNA Replication



Genetic Code

- **Specification of the correct sequence of amino acids in a polypeptide chain**
- **Each amino acid is represented by a triplet code**